Small Business Innovation Research/Small Business Tech Transfer

Highly Efficient Separation and Re-circulation of Unreacted CO2 in Mars ISRU System, Phase I

Completed Technology Project (2018 - 2019)

Project Introduction

Human exploration of Mars, as well as unmanned sample return missions from Mars can benefit greatly from the use of propellants and life-support consumables produced from the resources available on Mars

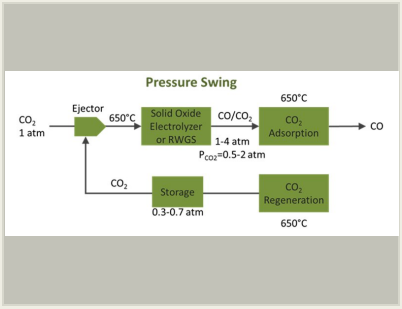
Mars' CO_2 rich atmosphere offers an abundant staring material on which to synthesize needed resources such as oxygen, carbon monoxide, and methane. The preferred method of oxygen generation uses a solid oxide electrolyzer (SOE) to produce oxygen in one stream and a mixture of carbon monoxide and carbon dioxide as the waste gases.

TDA Research proposes to develop a highly efficient system for separation and re-circulation of the unreacted CO_2 from the SOE processes. TDA's system uses a novel adsorbent that removes the unreacted CO_2 at temperatures > 650°C, without any need for cooling it down. The specific objective of the Phase I work is to develop a regenerable high temperature CO_2 sorbent that regenerates via thermal swing or pressure (vacuum) swing and demonstrate the ejector concept and thermal swing concept for gas recirculation in a breadboard system.

Anticipated Benefits

In the ISRU system not all CO_2 that is processed is getting utilized in the reverse water gas shift or the Solid oxide electrolysis step. Therefore, NASA is interested in technologies that allow the unreacted CO_2 from the RWGS (reverse water gas shift) and/or SOE (solid oxide electrolysis) reactors operating at high temperatures (>650°C), to be separated and recirculated back to the process inlet and the proposed sorbents must be able to take up CO_2 at these gas temperatures.

Potential non-NASA application includes pre-combustion CO_2 capture from Integrated gasification combined cycle power plants and from gasification systems. TDA's CO_2 removal system would find application in reducing greenhouse gases from power plants and in hydrogen manufacture.



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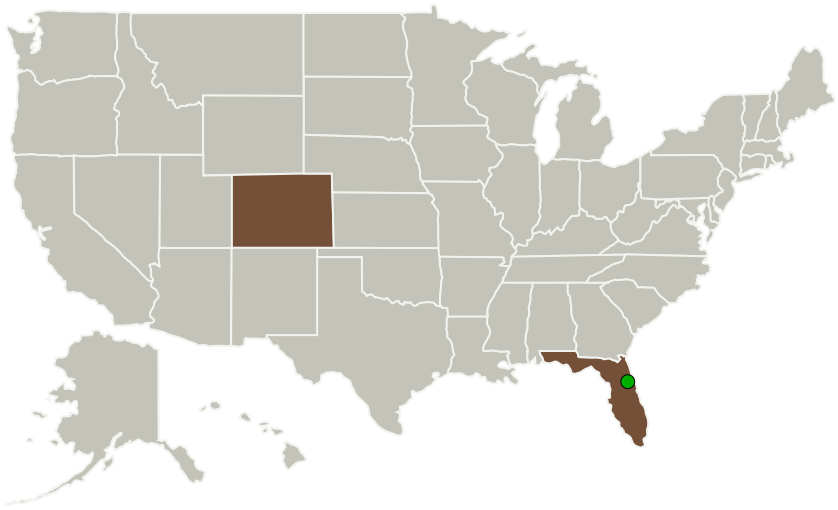
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
TDA Research, Inc.	Lead Organization	Industry	Wheat Ridge, Colorado
Kennedy Space Center(KSC)	Supporting Organization	NASA Center	Kennedy Space Center, Florida

Primary U.S. Work Locations	
Colorado	Florida

Project Transitions

July 2018: Project Start

February 2019: Closed out

Closeout Documentation:

- Final Summary Chart*(https://techport.nasa.gov/file/141368)*

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

TDA Research, Inc.

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

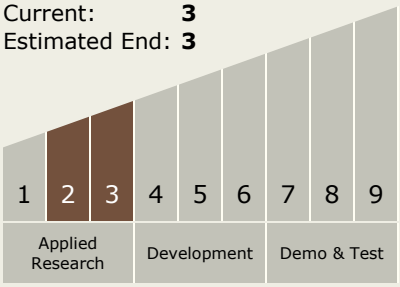
Carlos Torrez

Principal Investigator:

Ambalavanan Jayaraman

Technology Maturity (TRL)

Start: **2**
Current: **3**
Estimated End: **3**



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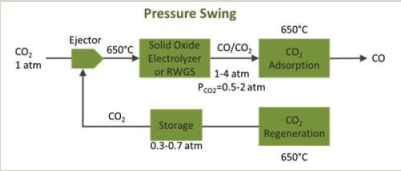
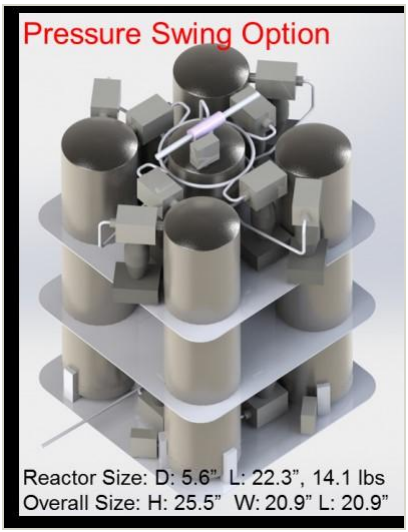
Images



Briefing Chart Image
Highly Efficient Separation and Re-circulation of Unreacted CO2 in Mars ISRU System, Phase I *(https://techport.nasa.gov/image/128825)*



Final Summary Chart Image
Highly Efficient Separation and Re-circulation of Unreacted CO2 in Mars ISRU System, Phase I *(https://techport.nasa.gov/image/137214)*

Technology Areas

Primary:

- TX07 Exploration Destination Systems
  - TX07.1 In-Situ Resource Utilization
    - TX07.1.3 Resource Processing for Production of Mission Consumables

Target Destination

Mars